GEOLOGY ALONG PHELPS CREEK, ASHTABULA COUNTY, OHIO

A THESIS

Presented in Partial Fulfillment of the
Requirements for the Degree of
Bachelor of Science

by

Robert Wetzel Carroll

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Approved by

Advisor
Department of Geology

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INTRODUCTION

Location

The area under consideration in this thesis, Phelps Creek, is located in Ashtabula County which is the most northeastern county in the state of Ohio (Figure 1A). Although the stream heads in Geauga County, the majority of the stream flow lies within Windsor Township in the southwest corner of Ashtabula County (Figure 1B). The maps that are used in Figures 2, 3, and 4 are portions of the Windsor, Ohio 7½' quadrangle topographic map which is the southwest quarter of the Jefferson 15' quadrangle. Phelps Creek is in Township 8 North and Range 5 West.

Purpose

The objective of the paper is to present a report on the general geology of the Phelps Creek area based on field observations and previously published reports. The area is of special interest to me because of the close proximity to my hometown which is located in Trumbull County, just 27 miles to the south. The field work was started in August of 1983 and was completed in October of the same year.

LOCATION

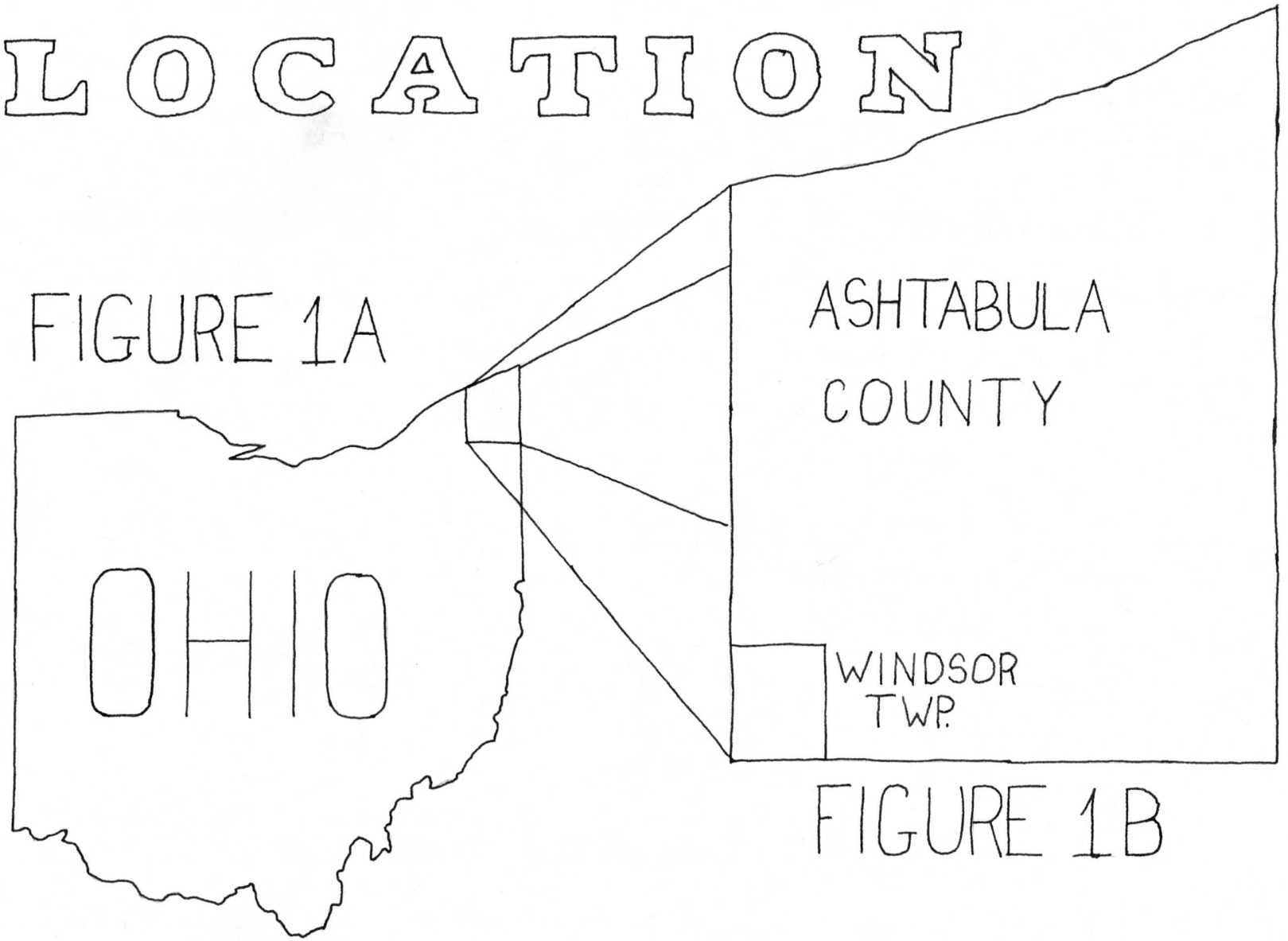


FIGURE 1A

FIGURE 1B

Acknowledgements

Sincere appreciation is extended to Dr. Russell Utgard for his guidance in his role as my advisor and for the patience, understanding, and helpful suggestions that he gave me in the process of preparing this paper. To David Little and the Department of Geology at the Ohio State University, a big thanks for the use of the Brunton compass, binocular microscope, and other facilities. My deepest gratitude goes to Frank Wilson, the executive director of Camp Wildwood, who allowed me to use the camp as a type of "homebase" and for allowing me to enter and do my research at a time when the camp was being used by several organizations. Without his cooperation, this study would have never come about.

PHYSIOGRAPHY

Relief

The area surrounding Phelps Creek is relatively flat-lying with elevations near the head of the creek at 1090 feet and at 800 feet where it empties into the Grand River. Thus the total relief in the Phelps Creek drainage system is only 290 feet. Most of the land in the area is gently rolling farmland except near the banks of Phelps Creek and towards the east where the land slope is sometimes much greater.

The Phelps Creek-Windsor, Ohio area is geographically located in what is known as the Southern New York section of the Appalachian Plateau Province. Fenneman and Johnson[1] who described the area said that it is "a mature glaciated plateau of moderate relief."

With the low relief, small creeks and streams found in the area, and the number of swamps that can be found in the area, it is evident that the erosional process is still in a youthful stage. Drainage in some areas is not very good and swamps appear in some of the flat, lower-lying areas.

Drainage

The area around Windsor and Windsor Mills is drained by four streams; Indian Creek, Phelps Creek, Mill Creek, and the Grand River. Of these streams, the Grand River is the largest and is fed by two of the other three streams; Mill Creek and Phelps

[1]Fenneman, N.M., and Johnson, Douglas W., Physiographic Divisions of the United States, U.S. Geological Survey map.

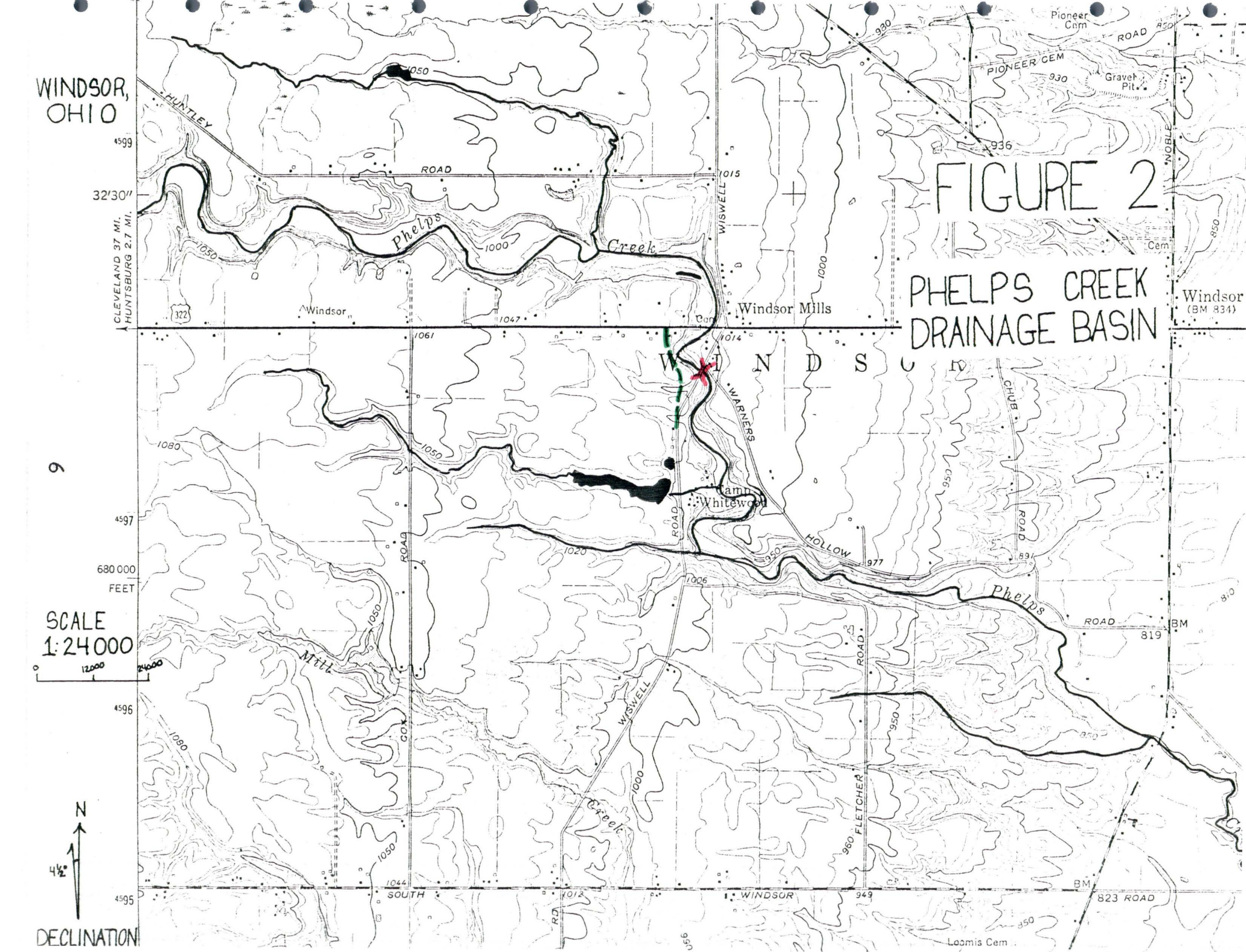
Creek.

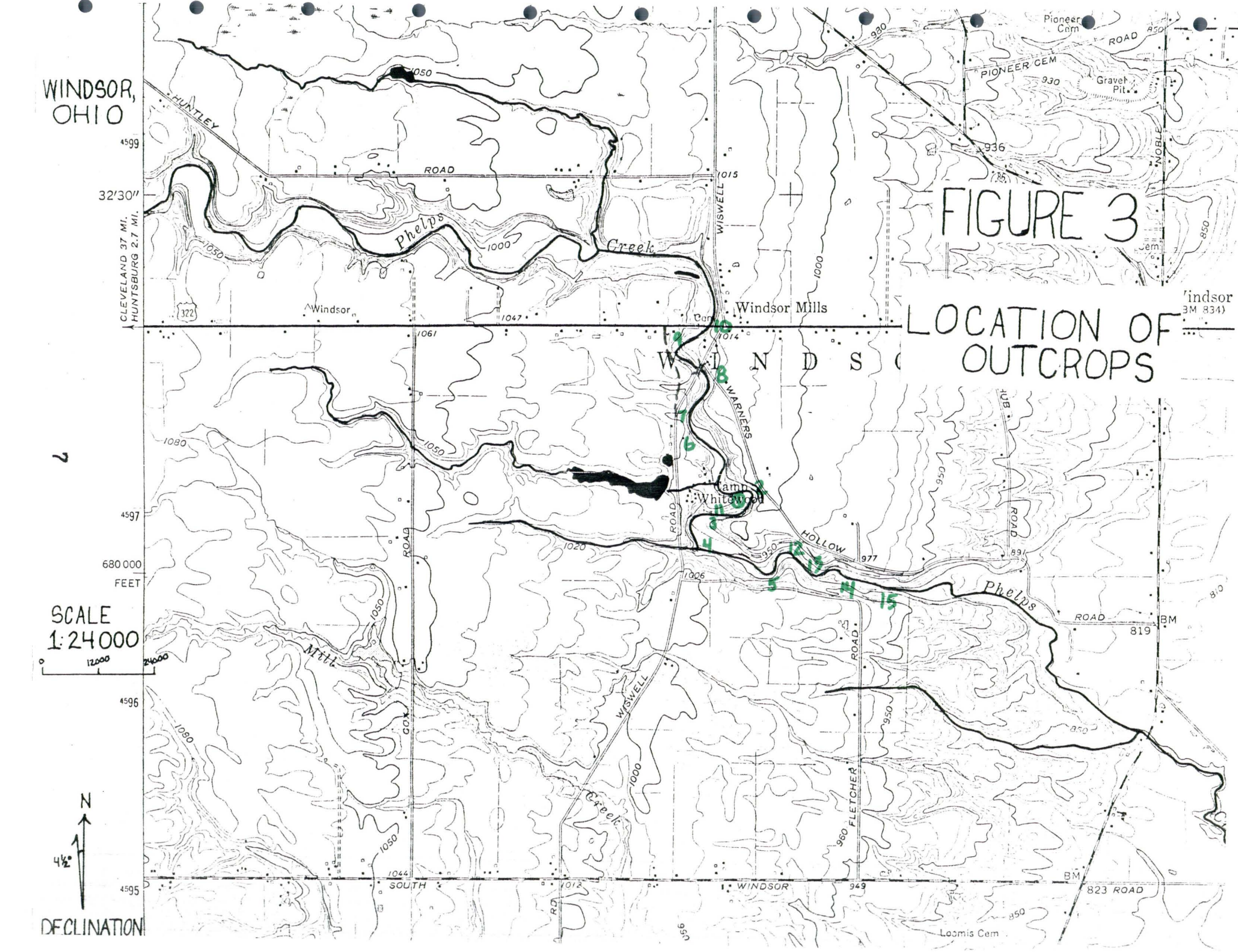
Indian Creek, the northernmost of the four streams, has a flow that is towards the east. The creek starts in Geauga County, the county just west of Ashtabula County, and flows east passing near the small town of Stoneville. From here the stream takes a more northeasterly course to where it empties into Hoskins Creek, coming from the north, and then they empty into the Grand River.

Mill Creek, the stream just south of Phelps Creek, does not flow for any great distance in Windsor Township. It too has its head in Geauga County and flows southeasterly into Ashtabula County. In the area of South Windsor Road, Mill Creek takes on a more southerly flow and empties into the Grand River in Trumbull County, the county that borders Ashtabula County on the south.

The Grand River, as mentioned previously, is the largest of the stream systems near Windsor. It has a northerly flow and has a number of tributaries that flow into it as it travels north. In places along its route there are some swampy areas along its banks, due to the bad drainage.

Phelps Creek, the area of interest, has its head in Geauga County just as do Mill Creek and Indian Creek. It flows east to the town of Windsor Mills in Ashtabula County where it takes on a southerly flow. After flowing in this direction for some distance, the stream resumes its eastward flow and ultimately empties into the Grand River. A map showing the route of Phelps Creek is shown in Figure 2.


WINDSOR, OHIO
FIGURE 2
PHELPS CREEK DRAINAGE BASIN
SCALE 1:24000
0 12000 24000
680 000 FEET
N
4½°
DECLINATION
32'30"
4599
4597
4596
4595
CLEVELAND 37 MI.
HUNTSBURG 2.7 MI.
HUNTLEY ROAD
Phelps Creek
Windsor
Windsor Mills
WISWELL
WARNER
HOLLOW
ROAD
Pioneer Cem
PIONEER CEM
Gravel Pit
NOBLE
Cem
Windsor (BM 834)
Camp Whitewood
Mill
COX
Creek
SOUTH WINDSOR RD.
FLETCHER
BM 823
Loomis Cem
322
1050
1000
1080
1020
1006
1044
1012
1047
1061
1014
1015
977
936
930
950
960
949
891
819
850
810


WINDSOR, OHIO
FIGURE 3
LOCATION OF OUTCROPS
SCALE 1:24000
680 000 FEET
DECLINATION
Windsor
Windsor Mills
Camp Whitewood
Pioneer Cem
PIONEER CEM
Gravel Pit
Phelps Creek
Mill Creek
WISWELL
WARNERS
HUNTLEY ROAD
PHELPS ROAD
FLETCHER ROAD
NOBLE ROAD
SOUTH WINDSOR RD
823 ROAD
HOLLOW
Loomis Cem
CLEVELAND 37 MI.
HUNTSBURG 2.7 MI.
32'30"
4599
4597
4596
4595

Glacial Geology

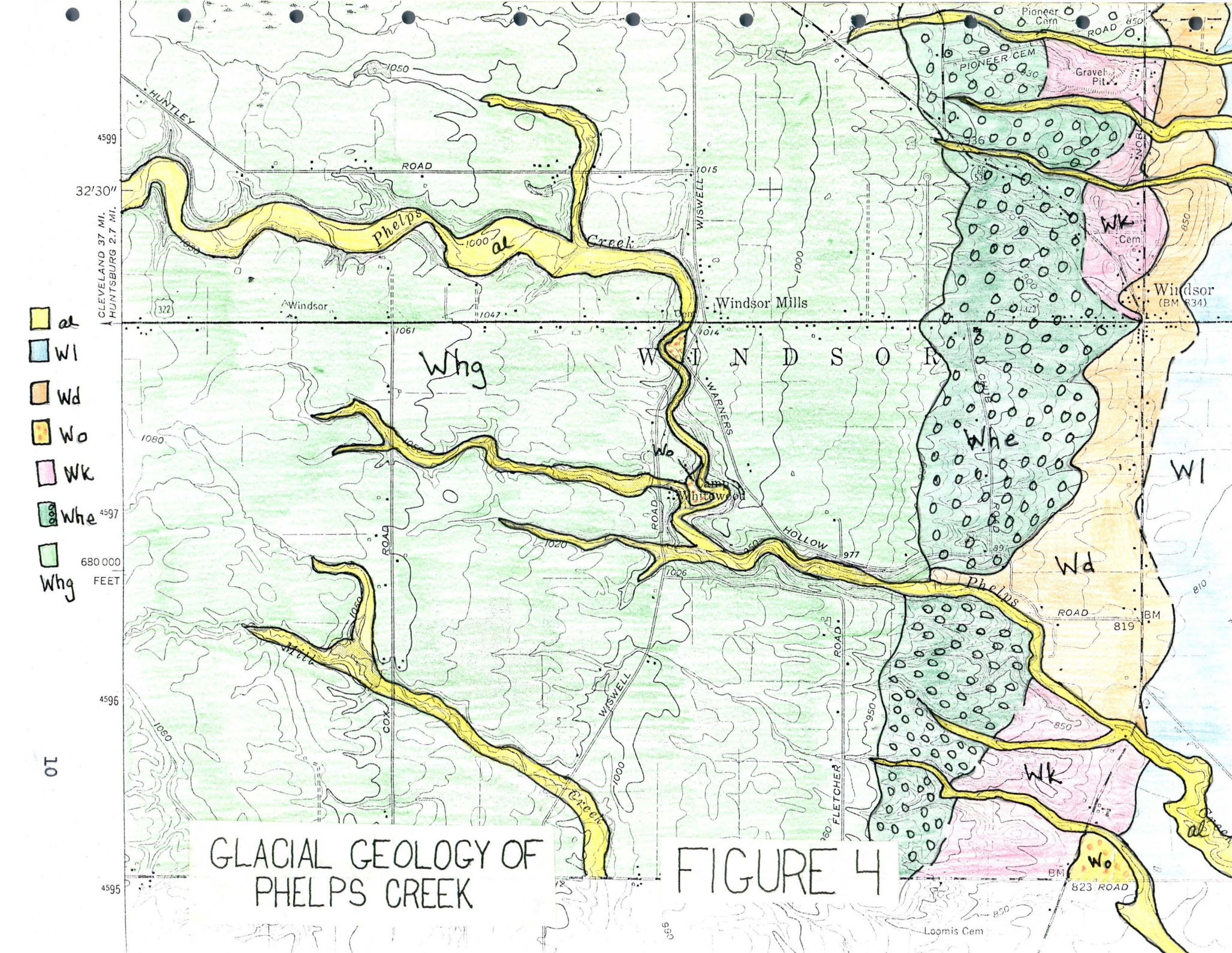
As far as glacial geology is concerned, Ashtabula County has had its share of glacial activity. The county is covered by glacial deposits from at least seven continental ice sheets that advanced from the north. All of these ice sheets, except for two, advanced past the southern border of the county. The Hiram Ice Sheet, the next to the last of the advances, did not cover the extreme southeastern portion of the county while the Ashtabula Ice Sheet, the last advance, only travelled into the county to approximately 8 miles south of the present Lake Erie shoreline.

A large part of Ashtabula County is covered with ground moraine that is generally flat and poorly drained. There are a few end moraines that run through the county. Figure 4 is a reconstruction of the glacial geology of Ashtabula County. The source for most of the information for the map and other information on the glacial geology is George White's and Stanley Totten's work entitled Glacial Geology of Ashtabula County, Ohio.

The explanation of the map is as follows:

- al- silt and alluvium, floodplains. Includes a few depressions which may contain muck or peat
- Wl- lacustrine plain. Silt and fine sand in Lake Plain, silty clay and clay in Grand River Lowland
- Wd- delta. Gravel and sand; along west side of Grand River Lowland
- Wo- outwash, valley trains, partly in terrace remnants. Generally coarse sands or fine gravel, but with some coarser gravel
- Wk- kames and kame terraces. Gravel and sand in knolls and and terraces; may be overlain by tills
- Whg- Hiram Till. ground moraine. clay till, generally less than 5 feet thick, and maybe much less
- Whe- Hiram Till. end moraine. clay till, generally thin, over earlier till or gravel forming bulk of moraine; gravelly part shown by overprint

As you can readily see in Figure 4, the majority of the western 3/4ths of the map area has a cover of ground moraine. Progressing eastward you reach one of the areas of an end moraine of the Hiram Ice Sheet. Outside of the end moraine is a remnant of a delta that emptied into the ancient Lake Plain. Overlying some of the deltaic deposits are kames and kame terraces. North of Windsor on Route 534, there is a gravel pit which uses the gravels from this deposit for road base and building material.



GLACIAL GEOLOGY OF PHELPS CREEK

FIGURE 4

STRATIGRAPHY

The bedrock along Phelps Creek is all sedimentary in origin, characterized by shales, siltstones, and sandstones. Above the bedrock, the area adjacent to the creek is covered by a thin layer approximately 6" thick of glacial deposits that are relatively unconsolidated. The outcrops of the sedimentary rocks were found along the stream banks of Phelps Creek. Towards the head of the stream the land surface becomes very flat and no outcrops are apparent until the section beneath the bridge on U.S. Route 322 that crosses Phelps Creek (Figure 3). The same dilemma becomes apparent when following the creek out towards its confluence with the Grand River. The land surface becomes very flat and even swampy in this area with no outcrops surfacing. This is why the outcrop locations in Figure 3 are all in the middle portion of the stream path.

At outcrop locations 1, 2, and 3, 6-8, and 11, the sediment types are predominately gray shales and siltstones with some yellow fine-grained sandstones. In some of these sandstone layers there are small areas of iron oxide staining. Ripple marks, tool marks, desiccation marks, and some organic matter can be found in these interbedded shales and siltstones. Cross-stratification, both trough and planar, can be seen in the sandstones as well as ripple marks and some bioturbation. The beds seem almost horizontal, however, there is a 1° to 2° dip to the east in all of the outcrops. Some pyrite nodules were found in these sediments also. When looking at the ripple marks, it seems

as though some layers suggest transport from one direction while the layer below it shows transport from another direction. These ripple marks occur in the siltstones and shales of the Chagrin.

Outcrop locations 4, 5, 9, 10, 12, and 13 all have thinly bedded black shale that is very platy and very much unlike the previously discussed outcrops with the gray shale. This black shale contains much more in the way of organics and shows more iron oxide staining when exposed to the atmosphere and other elements. The black shale does not show any of the sedimentary structures that the gray shale does. The deposits in these outcrops belong to the Cleveland Shale formation.

At outcrops 14 and 15, there is a deposit of calcareous tufa that was deposited by a spring that may have been in the area previously. It is extremely hard and is tan to light brown in color.

The outcrops with the gray shales, siltstones, and yellow sandstones are part of the formation known as the Chagrin Shale. The Chagrin Shale, which is Devonian in age, is comprised primarily of gray siltstones and shales with some interfingering of sandstones caused by deltaic deposits. The Chagrin Shale was named by C. S. Prosser in 1903 only after J. S. Newberry had given the deposit the name of the Erie Shale. However, the name Erie had already been used for another deposit elsewhere so the name was changed to the Chagrin Shale.

The outcrops containing the black shales belong to the formation known as the Cleveland Shale. The Cleveland Shale is recognized

by the thin, black, fissle shale that shows brown staining due to weathering processes. The Cleveland Shale was named by J. S. Newberry in 1870 for the exposures he saw near Cleveland, Ohio. The formation lies above the Chagrin Shale which was discussed in the previous paragraph. Along with the Chagrin Shale and the Huron Shale, which is not exposed in this section, make up the northern equivalent to the Southern Ohio deposit of the black Ohio Shale.

PALEONTOLOGY

While collecting rock samples from the area of Phelps Creek, I happened to find some fossils that are drawn in Figures 5, 6, and 7. In this section I will describe the fossils, their outcrop location, and attempt to name the fossils.

The fossil in Figure 5 is the outside portion of a shell of an inarticulate brachiopod which measures approximately 13 mm from front to back and 13 mm from side to side. It was found at outcrop location number 10, beneath the bridge on U.S. Route 322 (Figure 3, page 7). The sediment at this outcrop has been identified as the Cleveland Shale which is gray and black with some iron oxide staining in places. Also in the rock specimen in which the fossil was found there is an abundance of organic material. The mode of preservation of this fossil is replacement by silica. The inarticulate brachiopod is a marine organism which supports the theory of a marine depositional environment. With the aide of Dr. Stig Bergstrom, paleontology professor at the Ohio State University, we concluded the genus name for this fossil might be Orbiculoidea lodiensis Vanuxem, which is Devonian in age confirming the age of the deposit.

The fossil drawings in Figure 6 were also found in outcrop location 10, the Cleveland Shale. In this case, however, the area preserved is the inner portions of the shell. They measure

ACTUAL
SIZE

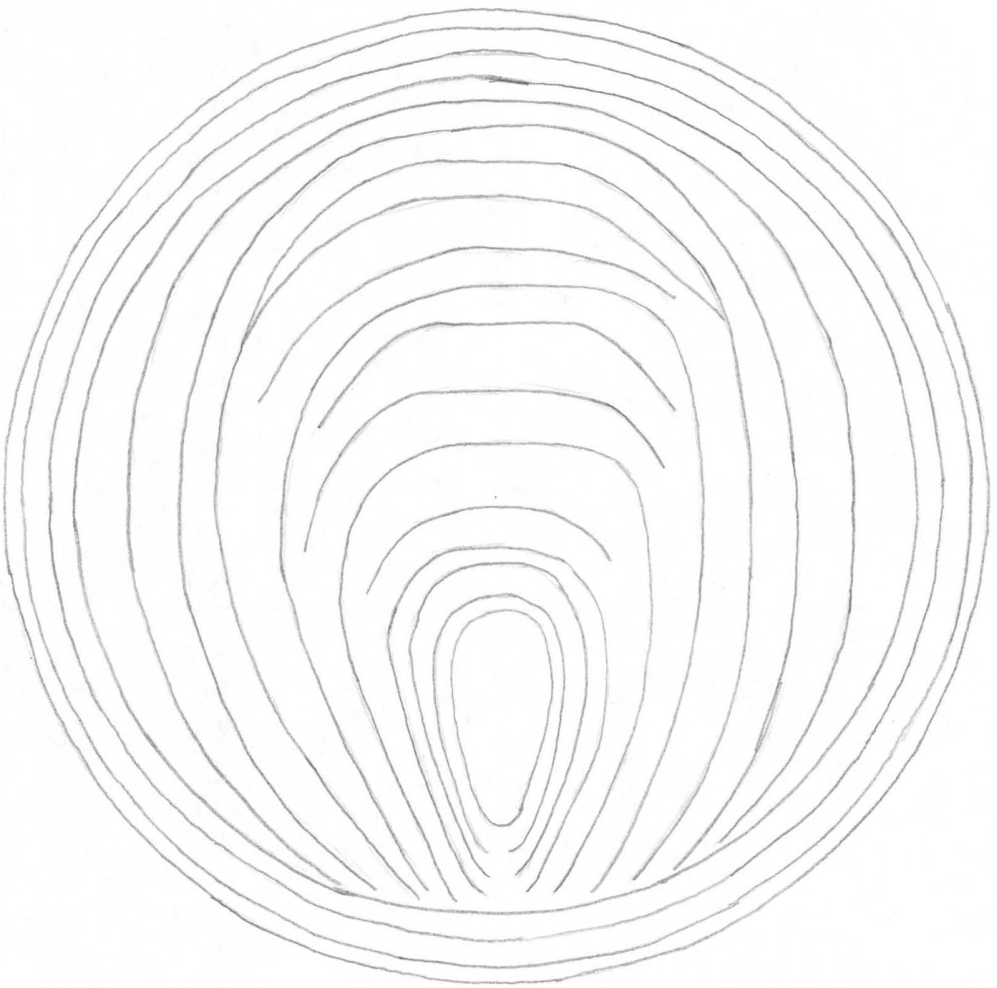
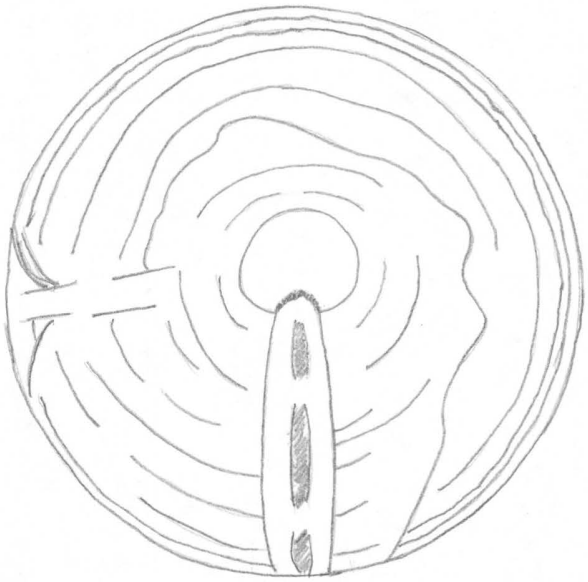


FIGURE 5

INARTICULATE BRACHIOPOD

ACTUAL SIZE



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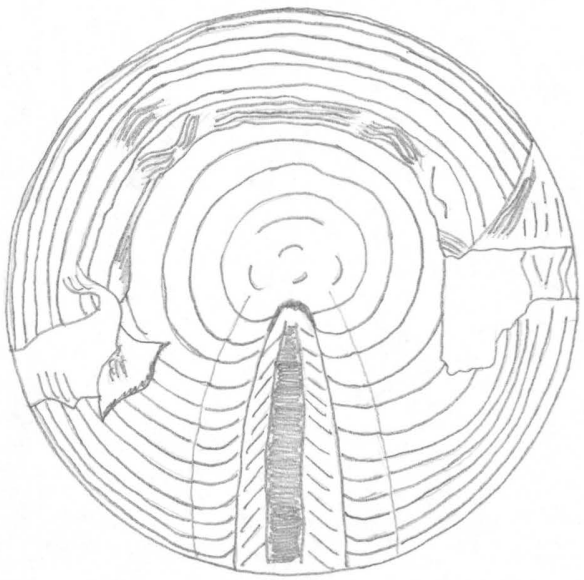

FIGURE 6 INARTICULATE BRACHIOPOD

approximately 9-10 mm from front to back and 8-9 mm from side to side. In the one half of the fossil the septum can be seen very clearly. The mode of preservation in this case is partial replacement by silica but with much of the original shell material still present. The fossil was also identified as the inarticulate brachiopod Orbiculoidea lodiensis Vanuxem.

The final fossil that is shown in Figure 7 was found in the gray Chagrin Shale at outcrop location number 2. There is also some organic material in this section. The mode of preservation of this fossil is a cast of the shell. The fossil is of an articulate brachiopod which I have identified as Schuchertella perversa.

CONCLUSIONS

From my field observations and research in previously published material, I can conclude that the deposits along Phelps Creek are the Devonian deposits of the Chagrin Shale and the Cleveland Shale. The Chagrin Shale is recognized by the gray shales and siltstones while the Cleveland Shale appears as a black, organic-rich, fissle shale.

ACTUAL SIZE

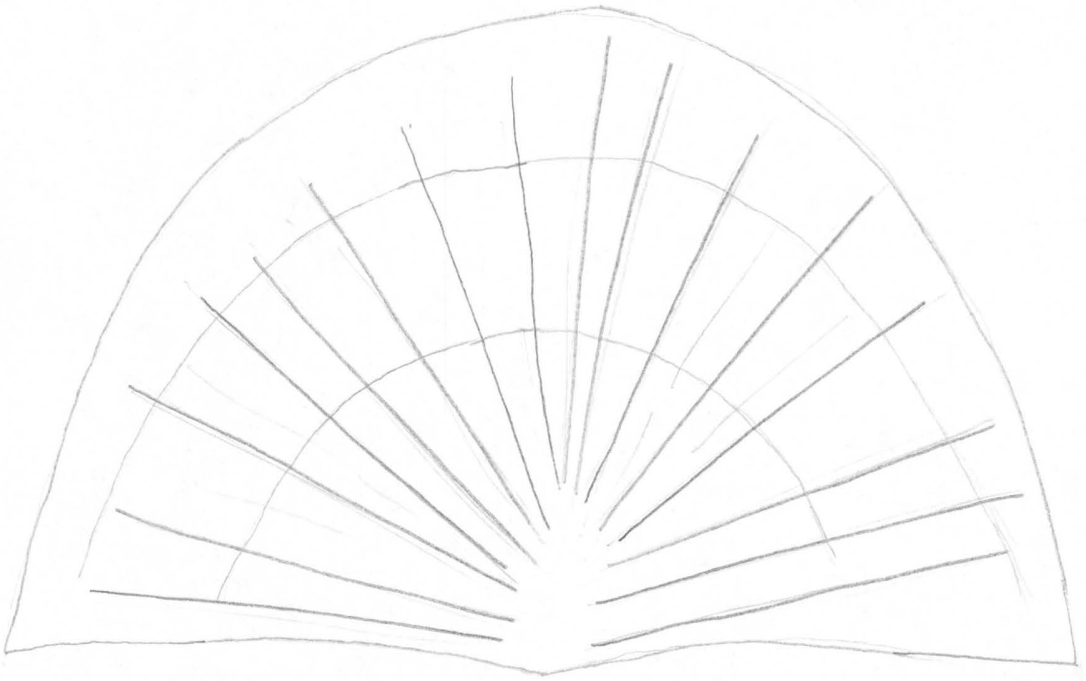

FIGURE 7

ARTICULATE BRACHIOPOD

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